MISCELLANEOUS PAPER NO. 4-949

EXPEDIENT SURFACE-SOIL SAMPLING

by

S. J. Knight

C. A. Blackmon

December 1967

Sponsored by

Office, Chief of Engineers
U. S. Army

Conducted by

U. S. Army Engineer Waterways Experiment Station
CORPS OF ENGINEERS
Vicksburg, Mississippi

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13. ABSTRACT

A study was made to determine practical, expedient methods of securing and containing surface-soil samples when soil sampling equipment is not available. Detailed examination of 24 cans, digging tests with three cans, and soil moisture-retention tests of eight types of covers indicated that any all-metal can makes a good tool for digging and containing surface-soil samples. A 12-oz beer can is judged to be a good choice for expedient surface-soil sampling because of its ubiquity, size, shape, sturdiness, and resistance to corrosion. A plastic cover that fits a round can snugly and two types of cloth-backed adhesive tape are considered to be effective covers for retaining the moisture in a soil sample in a can. Detailed procedures for surface-soil sampling are given.

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Foreword

The study reported herein was conducted as a part of the MEANWER program being pursued under Department of the Army Project 4A62040101 D859 for the Office, Chief of Engineers. These data were obtained during the period 7-18 August 1967 by Mr. C. A. Blackmon, Vehicle Studies Branch, Mobility and Environmental (M&E) Division, U. S. Army Engineer Waterways Experiment Station (WES), under the general supervision of Mr. W. J. Turnbull, Technical Assistant for Soils and Environmental Engineering, Messrs. W. G. Shockley and S. J. Knight, Chief and Assistant Chief, respectively, of the M&E Division, and Mr. A. A. Maxwell, Assistant Chief, Soils Division. This report was prepared by Messrs. Knight and Blackmon.

Director of the WES during this study was COL John R. Oswalt, Jr., CE. Mr. J. B. Tiffany was Technical Director.

Contents

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Conversion Factors, British to Metric Units of Measurement

British units of measurement used in this report can be converted to metric units as follows:

Multiply	By	To Obtain
inches	2.54	centimeters
feet	0.3048	meters
ounces	28.3495	grams
pounds	0.45359237	kilograms
Fahrenheit degrees	5/9	Celsius or Kelvin degrees*

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = (5/9)(F - 32)$. To obtain Kelvin (K) readings, use: $K = (5/9)(F - 32) + 273.16$.

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Summary

A study was made to determine practical, expedient methods of securing and containing surface-soil samples when soil sampling equipment is not available. Detailed examination of 24 cans, digging tests with three cans, and soil moisture-retention tests of eight types of covers indicated that any all-metal can makes a good tool for digging and containing surface-soil samples. A 12-oz beer can is judged to be a good choice for expedient surface-soil sampling because of its ubiquity, size, shape, sturdiness, and resistance to corrosion. A plastic cover that fits a round can snugly and two types of cloth-backed adhesive tape are considered to be effective covers for retaining the moisture in a soil sample in a can. Detailed procedures for surface-soil sampling are given.

EXPEDIENT SURFACE-SOIL SAMPLING

Introduction

1. For military reasons, it is often necessary to obtain a sample of soil on an impromptu or hastily planned basis. At such times, standard soil sampling equipment usually is not available and expedient devices must be employed.

2. A sample of soil that weighs at least 400 g usually is large enough to permit experienced laboratory technicians to determine texture or grain-size distribution, Atterberg limits, and field moisture content and to make simple chemical and mineralogical analyses. If care is employed, a sample that has been dug with a pocket knife or mess-kit spoon is just as suitable for determining this information as one that has been obtained with the finest scientific sampling device. Also, the sample may be as effectively transported, except for moisture losses, in a pocket handkerchief or C-ration can as in the most expensive container made for that purpose. With the proviso that steps be taken to preserve the water content in a soil sample while it is being transported, consideration was therefore directed to the use of common, everyday items for expedient surface-soil sampling purposes. Because the Army is said to travel on its stomach, thoughts naturally gravitated toward cans that contain food products, and because one of the most popular food products is beer, beer cans were given prominent consideration.

Purpose and Scope

3. The purpose of this study was to investigate the feasibility of using empty cans, particularly beer cans, to collect soil samples and as containers for the samples. A wide variety of grocery-product cans was examined. During the period 8-17 August 1967, limited experiments were conducted to determine the comparative merits of the various types as tools for digging samples and as containers, and of the moisture-retention properties of various kinds of covers.

Test Program

4. The test program consisted of the following:

   a. A comparison of the efficacy of several different kinds of cans as tools for digging soil samples and as receptacles for containing them.

   b. A study of the effectiveness of off-the-shelf plastic covers for cans as barriers against soil moisture loss.

   c. A study of the effectiveness of various common materials as moisture-loss barriers.

   d. Development of detailed procedures for surface-soil sampling, amply illustrated with photographs.

Pertinent test procedures, data, and results are described in the following paragraphs.

Tests of Cans as Digging Tools and Containers

Description of cans

5. The cans examined ranged in size from a 3-oz* tin (of potted meat) to a 2-lb tin (of coffee). All were round in cross section except two meat-product cans (Spam and Armour corned beef), which were rectangular. All except the rectangular cans had rounded edges; the two exceptions had sharp edges. All were made of metal except the soap-product (Woolite) can, which was made of paper with a metal top and bottom. The two rectangular cans were opened with a key which twisted a weakened strip of metal circumscribing the can. The other cans required a can opener or could be easily opened by cutting the paper top (Calumet baking powder), by lifting a "ring" or "tab" attached to a weakened aluminum top, or by sliding a built-in lever (Mixture 79 tobacco) or a knife or spoon (Woolite) around the shoulder of the top of the can to relieve the frictional force which held the replaceable top of the can. Representative cans examined are pictured in photograph 1. Dimensions, weights, and pertinent characteristics of the cans are listed in table 1.

Digging tests

6. Sometimes the only "tool" available for obtaining a soil sample

* A table of factors for converting British units of measurement to metric units is presented on page ix.

may be a can. Therefore, a limited study was made of the comparative merits of the different types of cans as sampling tools. For this purpose, the cans were considered to be of three types: sharp edged, lipped, and shouldered. These are represented by a corned beef can, a beer can, and a tobacco can, respectively.

7. The time required for a man to dig a hole approximately 25 cm in diameter and 15 cm deep with each can was determined in a small area of fairly soft soil. He was instructed to scrape the grass from the soil surface and dig the hole as rapidly as possible, using the can and his hands. The results of this experiment were as follows:

Can Used	Time Required, sec
Sharp edged	140
Lipped	135
Shouldered	420

8. The handicap to speedy digging offered by the shoulders on a can was immediately apparent, but the hole was nevertheless dug. The fact that digging with the lipped can required less time than digging with the sharp-edged can was somewhat surprising. It had been expected that the corned beef can would be the faster of the two because of its sharper edge, and this appeared to be true during the early stages of digging. However, as soon as the hole reached a size about the same as the cross section of the can, the man found he could dig faster with the sturdier lipped can because he could force it downward, shaving off sizable slivers of soil from the side of the hole. This could not be done with the corned beef can because it deformed severely under the force required. (The size, shape, and lip of the beer can rendered it sturdier even though its metal was thinner than that of the corned beef can.) There was also a tendency for the digger to proceed more carefully, and thus more slowly, with the sharp-edged can for safety reasons. Photograph 2 shows the three cans used in this experiment after the holes had been dug. Note that the sharp-edged can had been significantly deformed.

9. Although this one experiment is hardly a solid basis on which to conclude that the lipped can will always be faster than the sharp-edged can (for all diggers and in all soil conditions), it nevertheless is

sufficient to judge the lipped can to be adequate for expedient surface-soil sampling in soft to moderately firm soils.

Containers

10. A can is a can, and one can is as good a container as another, superficially at least, provided a proper cover is furnished. There were, however, two attributes of the sharp-edged can that suggested its relative inferiority to the other two: (a) the rectangular shape and the distortion resulting from digging the hole made the task of covering the can somewhat more difficult, and (b) the sharp edge constituted a safety hazard. Assuming that a proper cover could be provided for the beer can (to be discussed later), there was little to choose between it and the shouldered can, which came with its own cover.

Plastic Covers as Moisture-Loss Barriers

Food-product can covers

11. Certain food-product cans come equipped with tight-fitting plastic covers that are used to protect the contents when the metal tops have been removed. Inasmuch as these covers are known to be quite effective in retaining the freshness and flavor of the products, it was considered worthwhile to examine their effectiveness as barriers against soil moisture losses.

12. Test procedure. Five pairs of off-the-shelf canned products with plastic covers were purchased. The tops of the cans were carefully removed and the contents of the cans emptied. The cans were then washed and dried and each can and its corresponding plastic cover weighed. Each can, except the two largest (cans 1 and 2 in table 2), was then filled to within approximately 1 cm of its top with a wet soil (heavy clay at about 32 percent water content) and was carefully capped with its plastic cover. The two largest cans were filled only to about the halfway mark. The samples then were weighed and placed (at 0900 on 8 August) on grass-covered ground beyond the influence of any building or other shade-producing or wind-sheltering obstruction. One can of each pair, the odd-numbered one, was placed with the cover facing up, the other with the

cover down. A hygrothermograph in an instrument shelter was placed nearby. Photograph 3 shows the cans described above and others to be described later and the instrument shelter.

13. After a 24-hr period the cans were weighed and the moisture loss, if any, computed. Then two of the cans (9 and 10) were immediately exposed for an additional 48-hr period. The contents of the other eight cans were removed and the cans examined for signs of corrosion. After the second exposure of cans 9 and 10, their contents also were removed and the cans were inspected for corrosion.

14. Results and discussion. The moisture-loss data are shown in table 2, and the temperature and relative humidity data in table 3.

15. After only a few minutes in the sunshine, moisture droplets could be seen on the underside of the transparent plastic covers (cans 1, 3, 5, and 9); and before the end of the first hour, the whole underside of each of the four transparent covers (the Puss'n Boots cover was opaque) was blanketed with droplets spaced fairly close together. Thereafter every inspection of the cans (all inspections were made during daylight hours) showed about the same condition. Photograph 4, showing can 1, is representative of this condition.

16. The plastic covers were highly effective in retaining moisture inside the can. Whether the can was placed top up or down did not appear to affect the results. The water loss after 24 hr varied from none to 0.12 percent of the sample weight. After 48 hr additional exposure, water loss of sample 9 had increased from 0.11 to 0.28 percent and that of sample 10 from 0.00 to 0.17 percent.

17. Only the two Calumet baking powder cans (samples 9 and 10) showed any significant evidence of corrosion. A small amount could be seen near the top after 24 hr, and after 72 hr (total) approximately 10 percent of the inside surface of the can was covered with rust.

Plastic covers on beer cans

18. The plastic cover was notably effective as a moisture-loss barrier, and the omnipresent beer can was adequate as a digger and container. Combining the two was an obvious step; however, no manufacturer

of beer was known to furnish plastic covers with his product, and no cover found fitted a beer can. A telephone inquiry revealed that the Redman Manufacturing Company, 1630 Oakland, Kansas City, Missouri 64126, is now engaged in making a plastic top for Pepsi Cola cans (apparently the same size as beer cans) and offered to furnish a few samples. The company quoted a price of $9.20 per thousand in lots of 10,000 for the Pepsi Cola plastic tops and a price of $8000 to make a new mold for plastic tops of a not very different size.

19. Three "sample lids - #211" subsequently were received and were found to fit the 12-oz beer cans snugly. These covers and cans were tested in the same manner as previously described. Temperature and relative humidity during the tests are given in table 3. The test results appear in the following tabulation.

Sample No.	Product	Wt of Sample, g 1700 14 August	Water Loss After 24 hr g	Water Loss After 24 hr %	Water Loss After 72 hr g	Water Loss After 72 hr %
32	Schlitz	555.2	0.0	0.00	0.20	0.04
33	Old Milwaukee	486.7	0.0	0.00	0.15	0.03
34	Budweiser	531.6	0.1	0.02	0.10	0.02

These results show that the Redman-made plastic cover did an extremely good job as a moisture-loss barrier for 12-oz beer cans.

20. No evidence of corrosion was seen in this test.

Miscellaneous Covers as Moisture-Loss Barriers

Types of covers

21. Because plastic covers will not always be available to protect soil samples in cans, a study was made of the effectiveness of thin rubber membranes, plastic bags, surgical tape, surgical tape with sponges (bandages), and "gray" tape as moisture-retaining devices. Such items are commonly available. Gray tape is a cloth-backed adhesive tape very similar to surgical tape. It comes in 5-cm-wide rolls 55 m in length.

Test procedures

22. Various types of cans were used in this test series. Each was filled with soil of the same type and water content as used previously. A thin rubber membrane was stretched over one of the smallest (10-oz) beer cans, and three rubber membranes were applied to another. One of the 10-oz beer cans was placed inside a plastic bag, and the top of the bag was twisted tightly and held in the twisted position with a rubber band. Another (12-oz) can was placed inside two plastic bags, and a third (16-oz) can inside three plastic bags, which also were closed off with a rubber band. Surgical tape was applied as covers to two 12-oz beer cans, two corned beef cans, and two Spam cans. Two medical sponges were placed on top of the soil in another 12-oz beer can and four sponges on top of the soil in a similar can, and both cans were covered with surgical tape. Gray tape was used on two beer cans. The tapes were applied by laying strips across the top of the can and down the sides, overlapping them, until the top was completely covered, and then wrapping a strip around the circumference of the can over the ends of the strips previously applied. The friction-fit metal tops were simply placed tightly on their respective cans (four cans).

23. After the cans were covered, initial weights were obtained and the cans were exposed in a top-up position for 24 hr, beginning at 0900 on 9 August. Weights were then measured and moisture losses determined. Some of the cans (see table 4) were exposed for an additional 48 hr and weighed again at the end of that time.

Results and discussion

24. Moisture-loss data are shown in table 4, and temperature and relative humidity data in table 3.

25. Surgical tape with and without sponges and gray tape were very effective moisture-loss barriers. The moisture loss from samples in the cans so covered (Nos. 11-16 and 24-27) ranged from none to 0.04 percent in 24 hr. Eight of these 10 cans were exposed an additional 48 hr, at the end of which time the moisture losses ranged from 0.04 to 0.21 percent, and averaged only 0.10 percent.

26. The cans with the integral metal tops (Nos. 28-31) also held

moisture very well. The two tobacco cans showed no moisture loss, and the two soap cans showed losses of 0.02 and 0.17 percent after 24 hr.

27. Three of the cans of soil (17, 18, and 19) were enclosed in one, two, and three plastic bags, respectively. Sample 17 suffered a 0.15 percent weight loss, but the other two lost only 0.02 and 0.04 percent, respectively, after 24 hr.

28. The thin rubber membranes stretched and broke under the hot sun (see photograph 5), and thus are considered impracticable as covers.

29. Only one can in this series, the corned beef can, showed any evidence of corrosion, and this was only a small amount at the top of the can.

Procedures for Expedient Surface-Soil Sampling

30. The common 12-oz beer can is 11.8 cm high, 6.5 cm in diameter, and has a volume of 391.5 cc. When filled in a normal manner to within about 1 cm of the top, it holds from 450 to 500 g of wet soil. If tightly packed, an additional 100 g or so can be contained. The beer can possesses good corrosion-resistance properties, is not easily deformed, and can be quickly and effectively covered with one of several kinds of covers to minimize moisture losses. For these reasons, a beer can was selected to illustrate procedures for expedient soil sampling. The procedures would, of course, apply as well to nearly any other kind of can.

31. Four separate steps are identified in the procedures: removing surface debris, digging the sample hole, filling the can, and covering the can. These steps are described in detail in the following paragraphs and are illustrated, for several different situations, in photographs 6 through 9.

a. Removing surface debris. Leaves, branches, litter, vegetation, stones, etc., should be removed from the surface and the bare soil exposed. This is preferably done with a knife (as illustrated in photographs 6 and 7), but obviously may also be done with a stick, a can, a sharp stone, or even with the bare hands.

b. Digging sample hole. A hole 25 cm in diameter (a little more than twice the length of the can) and about 5 cm deeper than the depth of sample desired is a convenient size for good sampling techniques. A smaller hole may be employed when time is short. The hole may be dug with a knife, a stick, or the can itself (photograph 8).

c. Filling the can. The soil sample should be obtained from the wall of the hole, and the can filled to within 1 cm of the top. If practicable, slivers should be shaved from the top down to the bottom of the sample depth (not the bottom of the hole) with the can or any other convenient tool, in one motion if possible. If this is done, the material in the filled can then will accurately represent the soil in the sample depth specified. Good samples can also be obtained by scraping the hole horizontally or circumferentially, making sure that each increment of depth of sample is more-or-less equally represented in the whole sample (photograph 9).

d. Covering the can. The plastic cover, surgical tape, or gray tape may be used to seal the top of the can. Each cover is equally effective in preventing moisture losses. The plastic cover is easier and faster to employ, but it also is most likely to be dislodged in transit. Where possible, the plastic cover secured by a single strip of tape should be employed. Plastic and surgical-tape covers are shown being applied in photographs 10 and 11, respectively.

Conclusions

32. The limited testing performed in this study leads to the following conclusions:

a. Any all-metal can regardless of shape or size makes a good tool for digging and containing surface-soil samples.

b. A round-lipped can is preferred over (a) a round-shouldered can because it makes for speedier digging, (b) a rectangular can because it is easier to cover, and (c) a sharp-edged can for reasons of safety.

c. A 12-oz beer can is judged to be a good (probably the best) can for expedient surface-soil sampling because of its ubiquity, size, shape, sturdiness, and resistance to corrosion, and because of the facility with which it can be covered.

d. A plastic cover that fits a round can snugly and surgical and gray tape are effective means of retaining the moisture in a soil sample in a can.

e. Good surface-soil samples can be collected quickly and easily with a beer can if surface debris is removed, a hole 25 cm in diameter and 5 cm deeper than the desired depth of sample is dug, the soil sample is composited carefully from scrapings of the wall of the hole for the entire sampling depth, and the can is properly covered.

Table 1

Characteristics of Cans Examined

Product	Height of Can cm	Inside Diam of Can cm	Weight of Can g	Thickness of Metal in Can cm	Width of Lip of Can cm	Method for Opening Can	Built-in Method for Closing Can
Maxwell House coffee	16.2	12.5	187.8	0.028	0.124	Can opener	Plastic cover
Crisco shortening	7.9	9.8	76.2	0.023	0.142	Can opener	Plastic cover
Folger's coffee	10.6	7.6	76.4	0.028	0.142	Can opener	Plastic cover
Puss'n Boots cat food	10.8	7.3	65.8	0.023	0.127	Can opener	Plastic cover
Calumet baking powder	10.2	6.0	41.6	0.018	0.203	Knife*	Plastic cover
Mixture No. 79 tobacco	9.7	10.6	132.8	0.023	--	Built-in lever	Friction top
Woolite soap	8.1	8.1	54.8	0.089**	--	Lever	Friction top
Armour Vienna sausage	6.0	8.5	18.6	0.025	0.140	Pull tab	None
Libby's Vienna sausage	6.0	6.0	13.2	0.025	0.154	Pull tab	None
Red Bird potted meat	3.2	6.0	8.5	0.025	0.154	Pull tab	None
Baker's coconut	13.3	7.2	92.5	0.028	0.137	Pull tab	Plastic cover
Planters peanuts	6.9	8.2	61.6	0.023	0.140	Pull tab	Plastic cover
Miller beer, 16 oz	14.7	6.5	57.7	0.015	0.170	Can opener	None
Miller beer, 12 oz	11.8	6.5	48.1	0.015	0.170	Can opener	None
Budweiser beer, 12 oz	11.8	6.5	49.0	0.015	0.170	Can opener	None
Busch Bavarian beer, 12 oz	11.8	6.5	46.6	0.015	0.170	Can opener	None
Old Milwaukee beer, 12 oz	11.8	6.5	47.5	0.015	0.170	Can opener	None
Pabst Original beer, 12 oz	11.8	6.5	47.6	0.015	0.170	Can opener	None
Schlitz beer, 10 oz	11.8	6.0	42.5	0.015	0.124	Can opener	None
Schlitz malt liquor, 10 oz	8.1	6.5	38.0	0.015	0.170	Can opener	None
Budweiser beer, 10 oz	11.0	6.0	44.4	0.015	0.124	Can opener	None
Shasta strawberry soda	11.8	6.5	48.8	0.015	0.127	Can opener	None
Spam†	4.1	7.8	47.1	0.023	--	Key	None
Armour corned beef†	7.8	6.4	67.3	0.023	--	Key	None

* To cut heavy paper top under plastic cover.
** Paper container.
† Rectangular cans, diameter of equivalent circle is given.

Table 2

Plastic-Cover Tests

Can No.	Product	Initial Weights, g: Can, Cover, and Soil	Initial Weights, g: Can and Cover	Initial Weights, g: Sample (0900 8 August)	After 24 hr: Sample Weight g	After 24 hr: Water Loss g	After 24 hr: Water Loss, % Sample Weight	After 72 hr: Sample Weight g	After 72 hr: Water Loss g	After 72 hr: Water Loss, % Sample Weight
1	Maxwell House coffee	1452.0	201.0	1251.0	1250.0	1.0	0.08	--	--	--
2	Maxwell House coffee	1863.0	198.4	1664.6	1663.1	1.5	0.09	--	--	--
3	Crisco shortening	972.0	84.3	887.7	886.7	1.0	0.11	--	--	--
4	Crisco shortening	890.2	85.9	804.3	803.3	1.0	0.12	--	--	--
5	Folger's coffee	698.7	77.7	621.0	620.8	0.2	0.03	--	--	--
6	Folger's coffee	733.1	85.3	647.8	647.7	0.1	0.02	--	--	--
7	Puss'n Boots cat food	604.0	69.2	537.8	537.7	0.1	0.02	--	--	--
8	Puss'n Boots cat food	628.6	71.2	557.4	557.4	0.0	0.00	--	--	--
9	Calumet baking powder	399.2	44.9	354.3	353.9	0.4	0.11	353.3	1.0	0.28
10	Calumet baking powder	398.5	44.7	353.8	353.8	0.0	0.00	353.2	0.6	0.17

Note: Odd-numbered cans were placed top up, even-numbered ones top down.

Table 3

Temperature and Relative Humidity Data

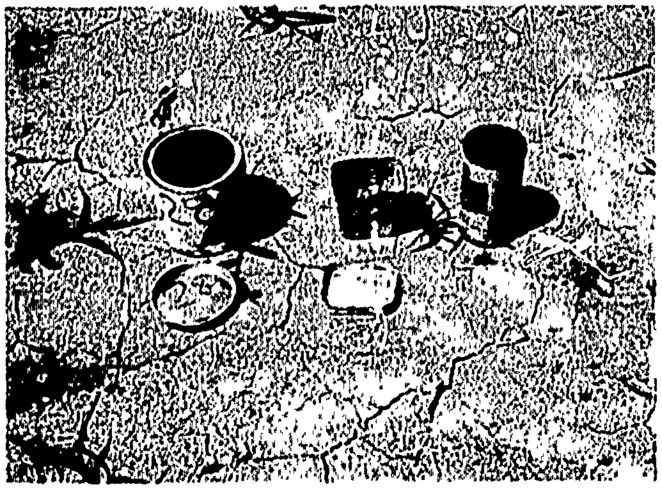
Date	Time	Temperature °F	Relative Humidity %	Remarks
8 August 1967	0900	90	74	Plastic-cover tests begun
	1300	92	62	Underside of plastic covers completely coated with water droplets
	1700	91	64	
	2300	83	100	
9 August 1967	0100	77	100	
	0500	74	100	
	0900	82	65	Miscellaneous-cover tests begun
	1300	92	42	
	1700	94	40	
	2100	84	98	
10 August 1967	0100	78	100	
	0500	75	100	
	0900	80	82	
	1300	83	70	
	1700	82	92	Single rubber membrane ruptured
	2100	77	90	
11 August 1967	0100	74	88	
	0500	72	72	
	0900	74	48	Plastic-cover tests ended
	1300	79	30	
	1700	78	32	Triple rubber membrane ruptured
	2100	70	42	
12 August 1967	0100	64	79	
	0500	60	92	
	0900	70	44	Miscellaneous-cover tests ended
	1300	78	26	
	1700	80	34	
	2100	73	48	
13 August 1967	0100	68	65	
	0500	64	87	
	0900	72	52	
	1300	82	43	
	1700	83	37	
	2100	72	94	
14 August 1967	0100	65	100	
	0500	61	100	
	0900	76	46	
	1300	86	25	
	1700	87	30	Tests of plastic covers on beer cans begun
	2100	78	70	
15 August 1967	0100	72	84	
	0500	68	100	
	0900	78	43	
	1300	85	38	
	1700	84	46	
	2100	75	90	
16 August 1967	0100	70	95	
	0500	70	98	
	0900	70	98	
	1300	77	65	
	1700	80	58	
	2100	74	98	
17 August 1967	0100	70	100	
	0500	69	100	
	0900	72	86	
	1300	83	48	
	1700	84	50	Tests of plastic covers on beer cans ended
	2100	76	100	

Table 4

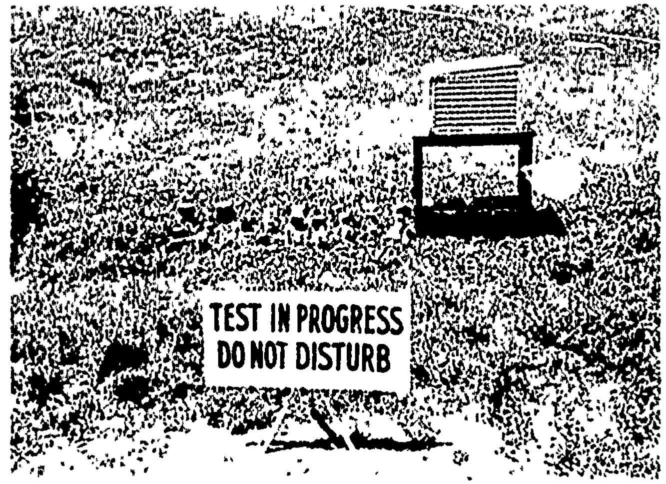
Miscellaneous-Cover Tests

Can No.	Product	Type of Cover	Weight of Sample (0900 9 August) g	Water Loss After 24 hr g	Water Loss After 24 hr % Wt of Sample	Water Loss After 72 hr g	Water Loss After 72 hr % Wt of Sample
11	Miller beer, 12 oz	Surgical tape	484.6	0.0	0.00	0.7	0.14
12	Budweiser beer, 12 oz	Surgical tape	528.7	0.0	0.00	0.2	0.04
13	Schlitz beer, 12 oz	Surgical tape and 4 sponges	553.5	0.0	0.00	0.6	0.11
14	Busch Bavarian beer, 12 oz	Surgical tape and 2 sponges	532.5	0.0	0.00	0.3	0.06
15	Pabst Original beer, 12 oz	Gray tape	516.5	0.1	0.02	0.9	0.17
16	Old Milwaukee beer, 12 oz	Gray tape	483.9	0.0	0.00	0.3	0.06
17	Schlitz malt liquor, 10 oz	1 plastic bag	390.3	0.7	0.15	--	--
18	Shasta strawberry soda	2 plastic bags	499.3	0.1	0.02	--	--
19	Miller beer, 16 oz	3 plastic bags	563.2	0.2	0.04	--	--
20	Schlitz beer, 10 oz	1 thin rubber membrane	419.2	--	--	--	--
21	Budweiser beer, 10 oz	3 thin rubber membranes	472.0	--	--	--	--
24	Armour corned beef	Surgical tape	374.9	0.1	0.03	--	--
25	Armour corned beef	Surgical tape	420.1	0.1	0.02	0.2	0.05
26	Spam	Surgical tape	235.9	0.1	0.04	0.5	0.21
27	Spam	Surgical tape	229.8	0.1	0.04	--	--
28	Mixture No. 79 tobacco	Metal top, friction fit	1249.4	0.0	0.00	0.0	0.00
29	Mixture No. 79 tobacco	Metal top, friction fit	1152.1	0.0	0.00	0.0	0.00
30	Woolite soap	Metal top, friction fit	557.6	0.1	0.02	0.5	0.09
31	Woolite soap	Metal top, friction fit	586.8	1.0	0.17	4.1	0.70

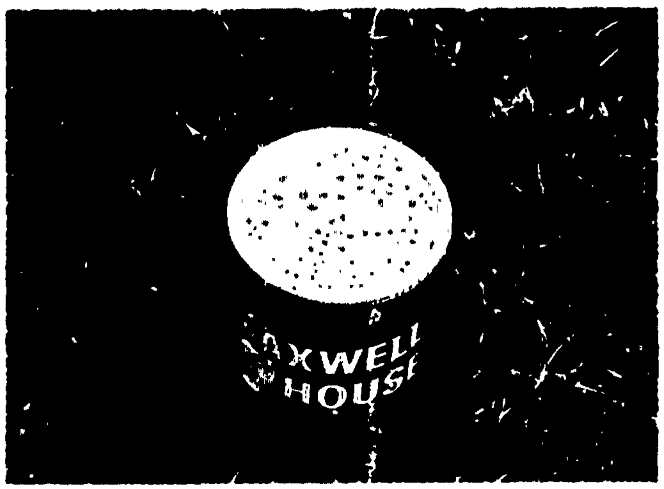
Photograph 1. Representative cans examined



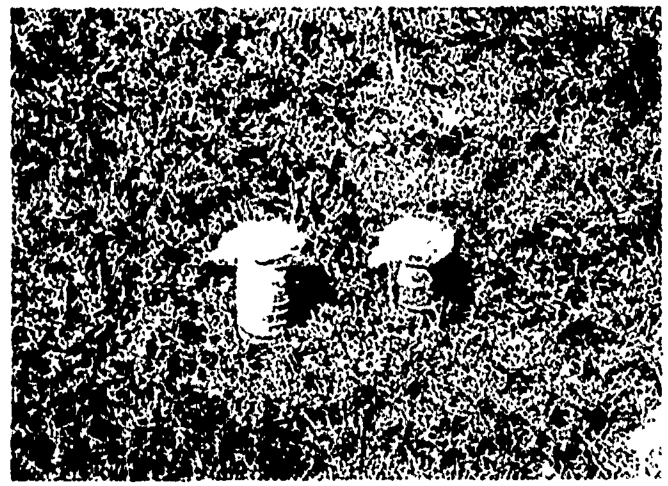
Photograph 2. Cans used in soil-digging tests



Photograph 3. Cans used in moisture-loss tests



Photograph 4. Moisture condensation on plastic cover

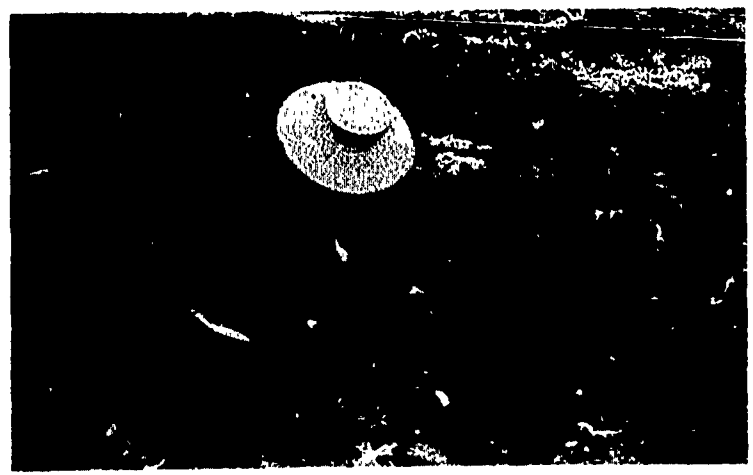


Photograph 5. Membrane-covered cans

a. Select site

b. Clear grass and litter

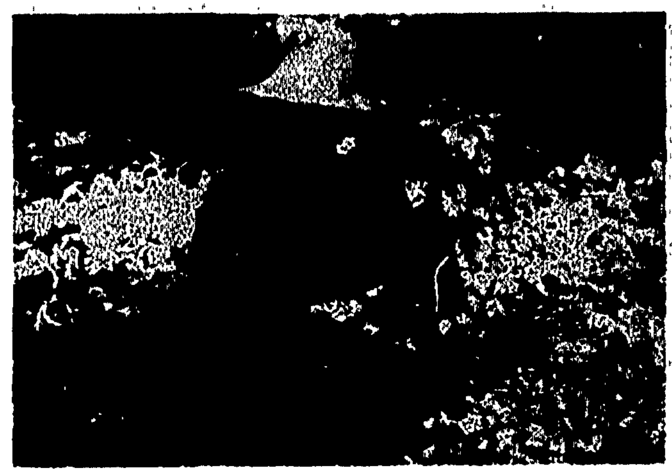
c. Dig hole deeper than can



d. Fill can from side of hole

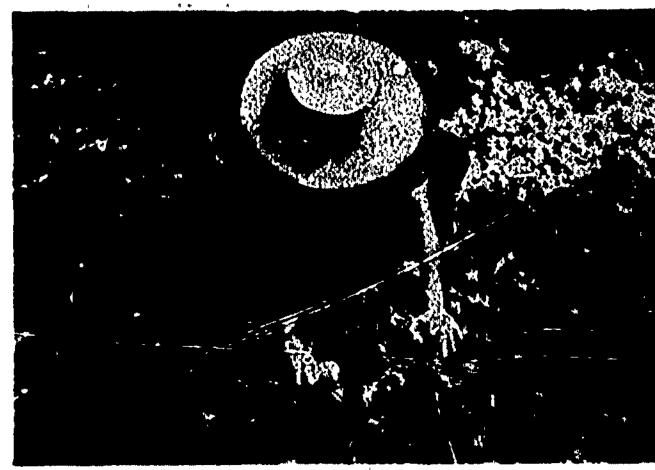
Photograph 6. Sampling in grassy area

a. Select site



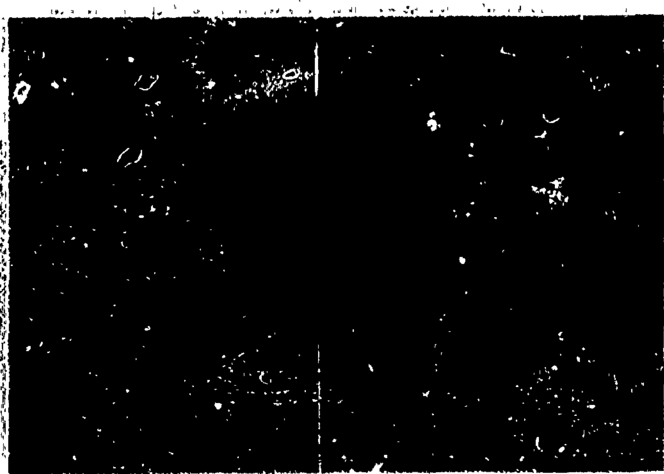
b. Clear leaves

c. Dig hole deeper than can

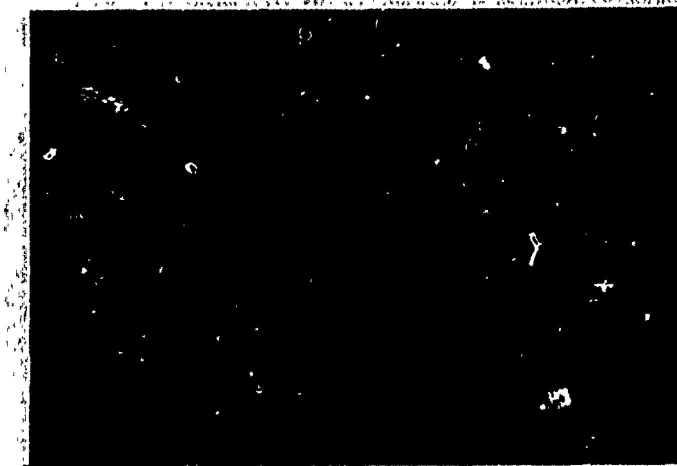


d. Fill can from side of hole

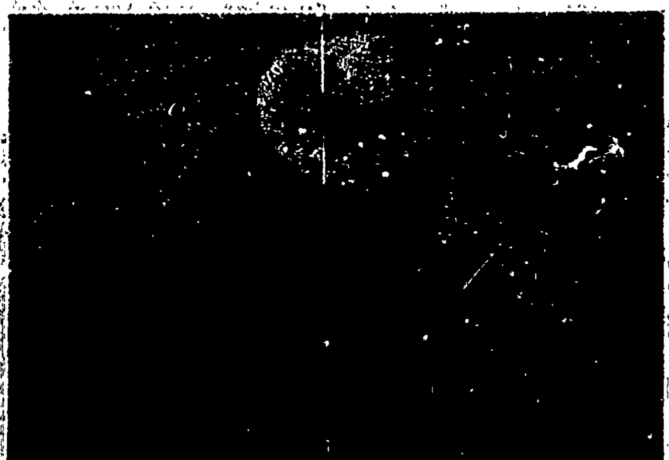
Photograph 7. Sampling in a leafy area



a. Dig with knife or stick



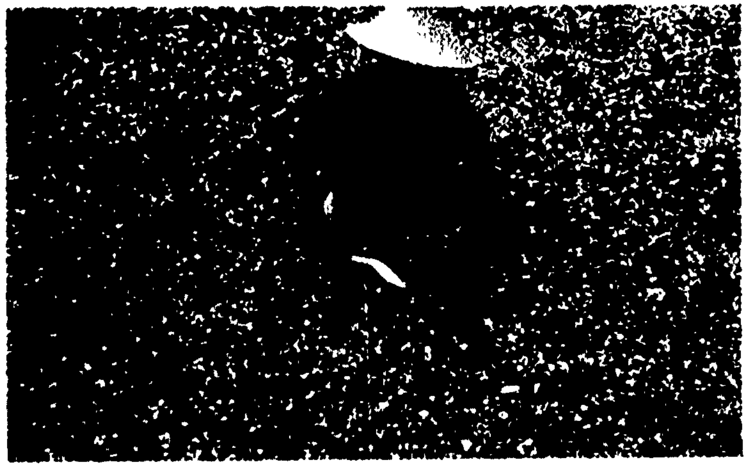
b. Or dig with can



c. Or dig with bare hands

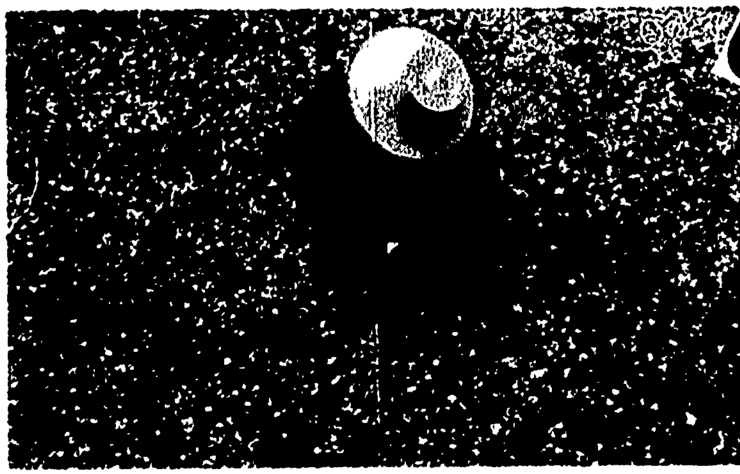
d. Fill can from side of hole

Photograph 8. Sampling in soft soil area



a. Select site

b. Scrape away surface layer



c. Fill by scraping with can

d. Or fill by hand

Photograph 9. - Sampling in rocky area

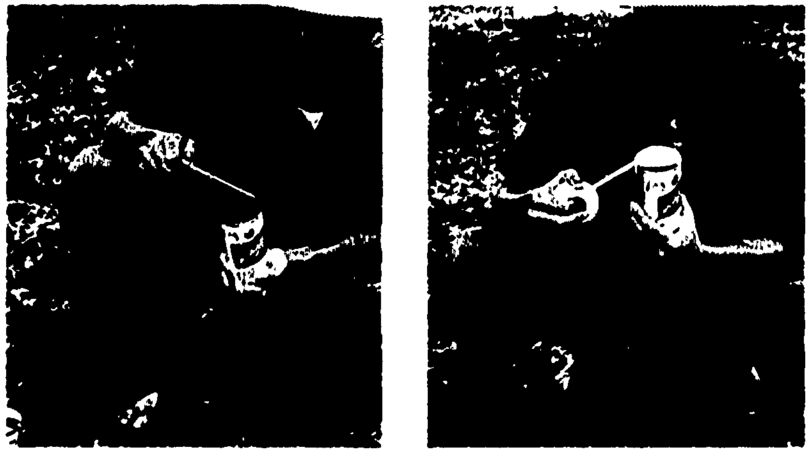
a. Put on plastic cover

b. Secure with a strip of tape

c. Or rubber bands

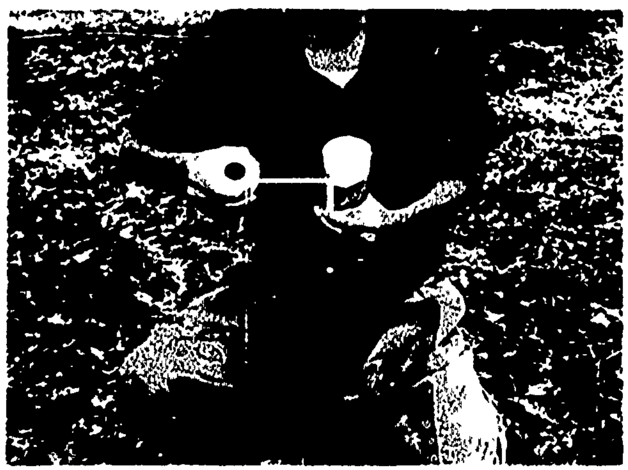
d. Or tie with string

Photograph 10. Covering the can with a plastic cover



a. Apply strips across top of can

b. Until can is covered



c. Apply strip around can

d. The covered can

Photograph 11. Covering the can with adhesive tape